

EXAMPLES

Electrical consumption

Determine the cost of using the following appliances for the period indicated. Use PHCN domestic rate

- i. 2000W water heater for 3 hours
- ii. Sixty 60W bulbs in a poultry from 7pm till 7am for a month.
- iii. An hammer mill with 2000W electric motor in a feedmill. It is normally operated non-stop only during official government working hours for 22 days in a month.

Solution

- $2000 \times 3 = 6000 \text{ WHr} = 6 \text{ KW Hr} @ \text{₦}4.00 \text{ per KW-Hr} = \text{₦} 24.00$
- $60 \times 12 \text{ Hrs} \times 30 \text{ days} = 21600 \text{ WHr}; \quad 21.6 \times 4 \text{ KW-Hr} = \text{₦} 86.40$
- $2000 \text{ W} \times 8 \text{ Hrs} \times 22 \text{ days} = 352000 \text{ WHr}; \quad 352 \times 4 \text{ KW-Hr} = \text{₦} 14,808.00$

Work that can be done with 1KWhr of electricity

Types of work possible with 1kW-Hr electricity

- (i.) Pumping 20 Litres or 500 gallons of water
- (ii) Milking 20 cows
- (iii) Cooling 40 Litres of water or milk for one day
- (iv) Shelling corn of 778.69 kg at a moisture content of 13% wet basis
- (v) Heating 16 Litres of water
- (vi) Running a tool grinder for 3 hours

Examples

1. Wire guage No 10 on the American Wire Guage has a current carrying capacity of 30A and a resistance of 0.9998 Ohm per 330 m. Calculate the voltage drop and the power loss if the wire is used to transmit power from a poultry house to the feed store which is about 0.33km away.

The current carrying capacity is over 330 m which is also = 0.33Km

$$\text{Voltage drop} = IR = 30\text{A} \times 0.9998\Omega = 29.94 \text{ V}$$

$$\text{Power loss} = I^2R = (30)^2 \times 0.9998 = 892\text{W}$$

2. During the operations in a feedmill, the meter disk makes 8.5 rev in 30 seconds. The meter K = 0.6 Watt/rev. What is the energy consumption? Calculate the monthly cost of operating the feedmill if the production capacity is an average of 3 bags/minute for a requirement of 1360 bags per day. The PHCN Industrial tariff rate is ₦8.00 per KWhr.

$$\begin{aligned} \text{Speed of rotation} &= 8.5\text{rev}/30 \text{ sec,} \\ \text{meter constant, K} &= 0.6\text{W}/\text{rev} \\ \text{Energy} &= \text{Power} \times \text{time (hr)} \\ \text{Speed of rotation (rev per Hr)} &= 8.5 \times 3600/30 = 1020\text{rev}/\text{hr} \end{aligned}$$

$$\text{Energy consumption} = K (\text{W}/\text{rev}) \times \text{Speed (Rev}/\text{hr}) = 0.6 \times 1020 = 612 \text{ W}/\text{hr}$$

$$\text{Rate} = 3 \text{ bags}/\text{min}$$

$$\text{Daily production} = 1350 \text{ bags}/\text{day}$$

$$\text{Daily operation time} = 1350/3$$

$$= 450 \text{ min}/\text{day} = 450/60 = 7.5 \text{ hr}/\text{day}$$

$$\text{Daily power consumption} = 7.5 \text{ hr} \times 0.612\text{Kw} = 4.59\text{KWhr}$$

$$\text{Monthly consumption} = 4.59 \times 30 = 137.7\text{KWhr}$$

$$\text{Tariff} = \text{N } 8.00 \text{ per KWhr}$$

$$\text{Total cost} = 137.7 \times 8.00 = \text{N}1,101.60 \text{ per month}$$

3. In a farm settlement, there are 5 pepper grinders using 2kW electric motor; 20 households (each with 12, 60W light bulbs; 5, 13A sockets; 2, 15A sockets; 2, 5A, sockets; 3, electric ceiling fans 20W); two saw mills each consuming 5kW; a feedmill (20kW), a livestock farm (20kW), palm oil processing mill (50kW), 2 cassava processing centres (15Kw each), Village market/recreation centre and hall (100kW).
- Calculate the amount the PHCN will be realising from the settlement on a monthly basis assuming an average 8 operating hours for all the users. (PHCN TARRIF = ~~N~~4.00 per kW-Hr)
 - As the only Agricultural Engineer in your states Rural Electrification Board, justify the reason why you are recommending that the 300kVA transformer in use should be changed.
 - Recommend and appropriate transformer to the Board.